

Appendix 1. Monte Carlo Program for Estimating Oil/Gas Accumulation Mix

As part of the 2008 U.S. Geological Survey (USGS) Circum-Arctic Resource Appraisal (CARA), a Monte Carlo program was used to probabilistically divide the total number of undiscovered accumulations between oil and gas accumulations. This appendix presents that program, explains the rationale for its construction, and provides a users' guide.

For most of the assessments done as part of CARA, the low level of exploration required the use of geologic analogs. The analog database used is available as Charpentier and others (2008). Analogs were often used to help estimate the numbers of undiscovered accumulations.

For a set of chosen analogs, a distribution of field densities per 1,000 square kilometers is constructed. Given the area of the assessment unit, this implies a distribution of number of fields. Generally, rather than consider oil field density or gas field density from the analog database, total field density is used. This is done in order to separate those geologic factors in the analog areas that affected the oil/gas mix.

For the input into the Monte Carlo estimation program, separate distributions are required for numbers of undiscovered oil accumulations and numbers of undiscovered gas accumulations. The general procedure, at least for frontier assessment units, is to estimate a total number of fields using a distribution of field densities from the analog database. The oil/gas phase program presented in this chapter combines this distribution of total fields with a distribution showing uncertainty in the mix of oil and gas fields. The program provides output in terms of separate

probability distributions for numbers of oil and gas fields. Any discovered fields in the assessment unit could be subtracted from those distributions.

The oil/gas phase program (OilGasPhase.xls) is a Monte Carlo program presented as a Microsoft Excel workbook. The Monte Carlo procedure requires Crystal Ball software to run.

The OilGasPhase.xls workbook includes four worksheets. Three of these accept as input a distribution for total fields and a distribution for uncertainty about the oil/gas mix. The three worksheets are distinguished by how the distribution for uncertainty about the oil/gas mix is expressed. Worksheet “OG Ratio” uses a distribution of the ratio of number of oil fields to number of gas fields. Worksheet “GO Ratio” uses a distribution of the ratio of number of gas fields to number of oil fields. Worksheet “Percent”, the one used in CARA, uses a distribution of the percent of total fields that are oil fields. These oil/gas mix distributions are all triangular distributions constructed from a minimum, mode, and maximum. The distributions for total number of undiscovered fields is commonly more skewed than would be appropriate for a triangular distribution, so, instead, a shifted truncated lognormal distribution is constructed from minimum, median, and maximum input values.

The fourth worksheet, “Phase”, does calculations in the opposite direction. The input is separate distributions for numbers of oil fields and gas fields. From these, the Monte Carlo program (using an assumption of independence between the two distributions) calculates the distribution of oil/gas mix as presented in the three definitions used on the other worksheets.